UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/054,543	01/18/2002	Ying-Chang Liang	1085-041-PWH	9245

21034 7590 02/08/2006

IPSOLON LLP
111 SW COLUMBIA
SUITE 710
PORTLAND, OR 97201

EXAMINER	
WARE, CICELY Q	
ART UNIT	**PAPER NUMBER**
2634	

DATE MAILED: 02/08/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/054,543	LIANG ET AL.
	Examiner	**Art Unit**
	Cicely Ware	2634

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 November 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 3-45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *1,3-7,44 and 45* is/are allowed.

6)☒ Claim(s) *8,9,12-14,, 24, 30, 31,33-37 and 39-43* is/are rejected.

7)☒ Claim(s) *10,11,15-23,25-29,32 and 38* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see **REMARKS/ARGUMENTS**, filed 11/14/2005 with respect to the rejection(s) of claim(s) 1-3, 6, 8, 9, 31, 36, 37, 42, 43 under 35 USC103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Horng et al. (US Patent 6,839,379), Onggosanusi et al. (US Patent Application 2003/0026349), Hamalainen et al. (US Patent Application 2004/0147227).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 8, 31, 36, 37, 42 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horng et al. (US Patent 6,839,379) in view of Gollamudi (US Patent Application 2003/0035490).

(1) With regard to claim 8, Horng et al. discloses in (Figs. 1-5) a method of achieving combined beamforming and transmit diversity (col. 4, lines 46-53) for frequency selective fading channels in a communication system having a base station

with multiple transmit antennae and a mobile terminal with at least a single receive antenna (col. 2, lines 41-51), the method comprising the steps of: providing a signal to be transmitted S(n;k) (col. 3, lines 11-19); feeding each output signal S.sub.1(n;k),S.sub.2(n;k) to a transmit processor (Fig. 1 (300)) to produce an output signal X.sub.1(n;k), X.sub.2(n;k) (col. 3, lines 1-49); applying respective selected transmit beamforming weights to each output signal X.sub.1(n;k), X.sub.2(n;k) (col. 4, lines 46-53, Fig. 4 (402, 411, 401)); feeding the respective weighted signals to a signal combiner to perform a summing function of the signals and produce a signal X(n;k) for transmission (Fig. 4 (401, 402, 411), Fig. 5); feeding the summed signal (X(n:k)) to each of the multiple transmit antennae for transmission; transmitting the signals X(n;k) over physical channel h(n;k); receiving the received signal Y(n;k) at least a single receive antenna (col. 1, lines 36-40, 51-67, col. 2, lines 41-67- col. 3, lines 1-63, col. 4, lines 46-53).

However Horng et al. does not disclose space-time encoding the signal S(n;k) to produce at least two separate signals S.sub.1(n;k),S.sub.2(n;k), each on a respective output; feeding the received signal Y(n;k) to a receive processor to produce an output signal; and space-time decoding the received signal.

However Gollamudi discloses in (Fig. 1) space-time encoding (12) the signal S(n;k) to produce at least two separate signals S.sub.1(n;k),S.sub.2(n;k) (18, 20), each on a respective output (PG. 3, col. 1, lines 15-26); feeding the received signal Y(n;k) to a receive processor(24, 28) to produce an output signal; and space-time decoding (24) the received signal (Pg. 2, lines 22-32, Pg. 4, lines 35-38, Pg. 5, lines 12-29, 48-51).

Therefore it would have been obvious to one of ordinary skill in the art to modify Horng et al. in view of Gollamudi to feeding the received signal Y(n;k) to a receive processor to produce an output signal; and space-time decoding the received signal. in order to keep up with a quickly changing channel between the base station and a high-speed mobile station (Gollamudi, Pg. 1, col. 2, lines 50-54).

(2) With regard to claim 31, claim 31 inherits all the limitations of claim 8. Gollamudi further discloses delaying one of the space-time encoded output signals by .DELTA..tau.; applying respective selected transmit beamforming weights to the delayed and undelayed signals in order to keep up with a quickly changing channel between the base station and a high-speed mobile station (Pg. 4, col. 1, lines 56-57, col. 2, lines 16-31).

(3) With regard to claim 36, claim 36 inherits all the limitations of claim 31. Gollamudi further discloses wherein the physical channel h(k) consists of two time-delayed rays h.sub.1(k), h.sub.2(k) with delay .DELTA..tau., the delay .DELTA..tau. is derived from downlink channel information in order to keep up with a quickly changing channel between the base station and a high-speed mobile station (Pg. 4, col. 2, lines 16-31, 38-41, 51-52, 61-62).

(4) With regard to claim 37, claim 37 inherits all the limitations of claim 31. Gollamudi further discloses wherein the physical channel h(k) consists of two time-delayed rays h.sub.1(k), h.sub.2(k) with delay .DELTA..tau., the delay .DELTA..tau. is derived from uplink channel information in order to keep up with a quickly changing

channel between the base station and a high-speed mobile station (Pg. 4, col. 2, lines 16-31, 38-41, 51-52, 61-62).

(5) With regard to claim 42, claim 42 inherits all the limitations of claim 31. See rejection of claim 36.

(6) With regard to claim 43, claim 43 inherits all the limitations of claim 31. See rejection of claim 37.

4. Claims 24, 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horng et al. (US Patent 6,839,379) in view of Gollamudi (US Patent Application 2003/0035490), as applied to claim 8, in further view of Onggosanusi et al. (US Patent Application 2003/0026349).

(1) With regard to claim 24, claim 24 inherits all the limitations of claim 8. Horng et al. in combination with Gollamudi disclose all the limitations of claim 8. However Horng et al. in combination with Gollamudi do not disclose at least two transmit processors each receiving one of the outputs from a respective space-time encoder.

However Onggosanusi et al. discloses in (Fig. 2) at least two transmit processors ($30_{1.1} - 30_{p.2}$) each receiving one of the outputs from a respective space-time encoder ($28_1 - 28_{p/2}$) (Pg. 4, col. 1, lines 44-67 – col. 2, lines 1-14, 27-40).

Therefore it would have been obvious to one of ordinary skill in the art to modify the inventions of Horng et al. in combination with Gollamudi to incorporate at least two transmit processors each receiving one of the outputs from a respective space-time

encoder in order to improve data rate and signal processing efficiency (Onggosanusi et al., Pg. 2, col. 2, lines 56-60).

(2) With regard to claim 30, claim 30 inherits all the limitations of claim 24. Gollamudi further discloses in (Fig. 1) a mobile terminal having at least a single receive antenna (28), a receive processor (23) to produce an output signal and a space-time decoder (24) to decode the output signal (Pg. 3, col. 1, lines 14-25).

5. Claims 9, 12-14, 33-35, 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horng et al. (US Patent 6,839,379) in view of Gollamudi (US Patent Application 2003/0035490), as applied to claim 8 and 31, in further view of Hamalainen et al. (US Patent Application 2004/0147227).

(1) With regard to claim 9, claim 9 inherits all the limitations of claim 8. Horng et al. in combination with Gollamudi disclose all the limitations of claim 8. However Horng et al. in combination with Gollamudi do not disclose wherein the respective transmit beamforming weights are selected as the eigenvectors corresponding to the two largest eigenvalues of the downlink channel covariance matrix (DCCM) of the physical channels.

However Hamalainen et al. discloses in wherein the respective transmit beamforming weights are selected as the eigenvectors corresponding to the two largest eigenvalues of the downlink channel covariance matrix (DCCM) of the physical channels h(n;k) (Pg. 1, col. 1, lines 27-31, col. 2, lines 28-67 – Pg. 2, col. 1, lines 1-39, col. 2, lines 9-23, Pg. 3, col. 2, lines 18-22).

Therefore it would have been obvious to one of ordinary skill in the art to modify the inventions of Horng et al. in combination with Gollamudi in view of Hamalainen et al. to incorporate wherein the respective transmit beamforming weights are selected as the eigenvectors corresponding to the two largest eigenvalues of the downlink channel covariance matrix (DCCM) of the physical channels in order to increase the downlink capacity in a wireless communication system where the transmitter can be provided with only a limited information of the channel state (Hamalainen et al., Pg. 2, col. 1, lines 58-61.

(2) With regard to claim 12, claim 12 inherits all the limitations of claim 8. Hamalainen et al. further discloses in (Figs. 1 and 2) wherein the physical channel h(n;k) consists of two time-delayed rays, h.sub.1(n;k) and h.sub.2(n;k), with delay .DELTA..tau., the beamforming weights being chosen such that the average transmit SINR function at the base station is maximized for each ray (Pg. 1, col. 1, lines 27-31, col. 2, lines 28-67 – Pg. 2, col. 1, lines 1-39, col. 2, lines 9-23, Pg. 3, col. 1, lines 9-13, 20-27, col. 2, lines 31-51).

(3) With regard to claim 13, claim 13 inherits all the limitations of claim 8. Hamalainen et al. further discloses in (Figs. 1 and 2) wherein the physical channel h(n;k) consists of two time-delayed rays, h.sub.1(n;k) and h.sub.2(n;k), with delay .DELTA..tau., the beamforming weights being chosen such that the average receive SINR function at the mobile terminal is maximized (Pg. 1, col. 1, lines 27-31, col. 2, lines 28-67 – Pg. 2, col. 1, lines 1-39, col. 2, lines 9-23, Pg. 3, col. 1, lines 9-13, 20-27, col. 2, lines 31-51).

(4) With regard to claim 14, claim 14 inherits all the limitations of claim 8. Hamalainen et al. further discloses in (Fig. 1 and 2) wherein the physical channel h(n;k) consists of two time-delayed rays, h.sub.1(n;k) and h.sub.2(n;k), with delay .DELTA..tau., the beamforming weights for each ray are chosen as the principal eigenvector of the downlink channel covariance matrix (DCCM) corresponding to that ray (Pg. 1, col. 1, lines 27-31, col. 2, lines 28-67 – Pg. 2, col. 1, lines 1-39, col. 2, lines 9-23, Pg. 3, col. 1, lines 9-13, 20-27, col. 2, lines 18-22, 31-51).

(5) With regard to claim 33, claim 33 inherits all the limitations of claims 31. See rejection of claim 12.

(6) With regard to claim 34, claim 34 inherits all the limitations of claims 31. See rejection of claim 13.

(7) With regard to claim 35, claim 35 inherits all the limitations of claims 31. See rejection of claim 14.

(8) With regard to claim 39, claim 39 inherits all the limitations of claims 31. See rejection of claim 12.

(9) With regard to claim 40, claim 40 inherits all the limitations of claims 31. See rejection of claim 13.

(10) With regard to claim 41, claim 41 inherits all the limitations of claims 31. See rejection of claim 14.

Allowable Subject Matter

6. Claims 10, 11, 15-23, 25-29, 32, 38 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The following is a statement of reasons for the indication of allowable subject matter: The instant application discloses a method of achieving transmit diversity gain for frequency selective fading channels in a communication system having a base station with multiple transmit antennae and a mobile terminal with at least a single receive antenna. Prior art references show similar methods but fail to teach: "**wherein the physical channel h(n;k) consists of two time-delayed rays, h.sub.1(n;k) and h.sub.2(n;k), with delay .DELTA..tau., the transmit processors do not add cyclic prefixes and one of the output signals from the transmit processors is delayed by .DELTA..tau. before the respective selected transmit beamforming weight is applied thereto**", as in claim 10, 15; "**wherein the physical channel h(n;k) consists of two time-delayed rays, h.sub.1(n;k) and h.sub.2(n;k), with delay .DELTA..tau., the beamforming weights being chosen such that the delayed signal or its inverse fast Fourier transform (IFFT) only goes through one channel h.sub.1(n;k) between the base station multiple transmit antennae and the receive antenna, whilst the undelayed signal or its IFFT only goes through another channel h.sub.2(n;k) between the base station multiple transmit antennae and the receive antenna, thereby creating two different channels which can be space-time decoded to recover the transmitted signal**", as in claim 11; "**wherein the beamforming weights**

are chosen such that the delayed signal or its inverse fast Fourier transform (IFFT) only goes through one channel h.sub.1(n;k) between the base station multiple transmit antennae and the receive antenna, whilst the undelayed signal or its IFFT only goes through another channel h.sub.2(n;k) between the base station multiple transmit antennae and the receive antenna, thereby creating two different channels which can be space-time decoded to recover the transmitted signal", as in claim 16; **"wherein the beamforming weights being chosen such that the average transmit SINR function at the base station is maximized for each clustered ray"**, as in claim 17; **"wherein the beamforming weights being chosen such that the average receive SINR function at the mobile terminal is maximized"**, as in claim 18; **"wherein the beamforming weights for each clustered ray are chosen as the principal eigenvector of the downlink channel covariance matrix (DCCM) corresponding to that clustered ray"**, as in claim 19; **"estimating a power-delay-DOA profile for channel h(n;k); and, based on the profile: determining the cyclic prefix, .DELTA..psi., to be added by the transmit processors; determining the delay .psi.; diversity order and modulation scheme; and determining the transmit beamforming weights"**, as in claim 20; **"estimating the downlink channel covariance matrix (DCCM) from the uplink channel covariance matrix (UCCM) to construct transmit beamforming weights"**, as in claim 21; **"determining the diversity order and modulation scheme based on the profile"**, as in claim 22; **"wherein the transmit and receive processors are selected from the group consisting of: OFDM, MC-CDMA MC-DS-CDMA and a single carrier system with**

cyclic prefix", as in claim 23 and 29; **"wherein the physical channel h(k) consists of two time-delayed rays h.sub.1(k), h.sub.2(k) with delay .DELTA..tau., the beamforming weights are chosen such that the delayed signal only goes through one ray h.sub.1(k) between the base station multiple transmit antennae and the receive antenna, whilst the undelayed signal only goes through another ray h.sub.2(k) between the base station multiple transmit antennae and the receive antenna"**, as in claim 32 and 38.

7. Claims 1, 3-7, 44 and 45 are allowed.

8. The following is a statement of reasons for the indication of allowable subject matter: The instant application discloses a method of achieving transmit diversity gain for frequency selective fading channels in a communication system having a base station with multiple transmit antennae and a mobile terminal with at least a single receive antenna. Prior art references show similar methods but fail to teach: **"deriving real channel coefficients from uplink channel coefficients for use in selecting the functions of the pre-equalizers"**, as in claims 1 and 6; **"wherein delay of $\Delta\tau$ is interposed between the space-time encoder and one of the beamformers such that the major components of the transmitted signals are received at at least a single receive antenna at the same time"**, as in claim 44.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Cicely Ware whose telephone number is 571-272-3047. The examiner can normally be reached on Monday – Friday, 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on 571-272-3056. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9314 for regular communications and 703-872-9314 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-3900.

Cicely Ware

cqw
February 6, 2006

CHIEH M. FAN
SUPERVISORY PATENT EXAMINER